Use of Zinc Alloys

The present invention relates to the use of zinc alloys as constructional zinc for strips and plates.

To date, strips and plates of alloyed zinc for building purposes have contained, in addition to zinc with a content of 99.99%, from 0.005 to 0.05% by weight of aluminum as well as additions of from 0.05 to 0.2% by weight of titanium and copper. This alloy is described, for example, in DE 17 58 498 and meets the standard DIN 17 770, part 1.

The preparation of this material is generally performed using the casting-and-rolling process in which strips are prepared in a predetermined thickness by a continuous procedure (melting - casting - rolling - winding), which strips are subsequently cut into narrow strips or plates on shear lines.

This material is highly stable in the atmosphere. Its surface first reacts with atmospheric oxygen to form zinc oxide. Then, by the action of water, zinc hydroxide is formed which is converted to a dense, firmly adhering and water-insoluble coat layer of basic zinc carbonate by reaction with atmospheric carbon dioxide. This protective layer is also responsible for the high corrosion resistance of such strips and plates.

In contrast to the behavior of the surface of zinc facing the free atmosphere, other conditions prevail on the lower side of the zinc strips and plates, i.e., on the side facing away from weathering influences. If the lower side of the zinc strips and plates is additionally exposed to moisture or condensed water for an extended period of time due to poor aeration and deaeration, enhanced corrosion must be

expected due to such mistakes of building physics and laying technology. Such water inclusions, water irruptions and condensation water eventually lead to punctual deep corrosion (pinholing) which can spread two-dimensionally.

To avoid these consequences, care has to be taken that sufficient aeration and deaeration of the base construction of zinc strip or plate coatings is provided by observing the prescriptions and regulations of the VOB and DIN standards as well as technical rules of the art and decrees of the building authorities.

Due to increased ecological demands on the resistance of these materials, it has been desired to develop materials having comparable mechanical properties, but with clearly more beneficial corrosion properties. The strips and plates previously used as constructional zinc lose 4 to 5 µm per year.

Such an improved material has been described in DE-A-195 45 487 and is characterized by a copper content of from 0.02 to 0.075% by weight and a manganese content of from 0.075 to 0.75% by weight. However, tests made on this material have shown that the demands made on such a material in practice are still far from being met, despite the considerable improvements.

From DD-4822, the use of zinc-aluminum alloys is known which contain from 1 to 63% of aluminum and from 99 to 37% of zinc and which are rendered suitable for objects having a high deformability, i.e., so-called superplastic behavior, by a special heat treatment. This is important to the drawing of wires and to the rolling, extruding, forging, deep-drawing of sheets, and to bending. There are no indications to the corrosion behavior of these alloys and thus their usability as constructional zinc for strips and plates.

DE 30 07 850 C describes the use of a zinc alloy as a powder for mechanical plating. In addition to improved corrosion resistance, above all, a perfect adhesion of the coating to the substrate is to be achieved. Thus, this is again a different use from that of such alloys as constructional zinc for beams and plates.

DE 914 785 describes a bearing alloy made of zinc, aluminum and other components in which the content of copper and/or manganese is to be about 1%. These alloys can be used as bearing and kneading alloys. These functions are completely different from the use of zinc alloys as constructional zinc for strips and plates.

The object to provide strips and plates of alloyed zinc for use as constructional zinc which meet even higher demands is now achieved, above all, by adjusting the aluminum content to from 5 to 35% by weight, preferably from 5 to 20% by weight, especially from 8 to 15% by weight. Further improvements are achieved by co-alloying from 0.002 to 0.04% by weight of indium and/or from 0.002 to 0.04% by weight of calcium and/or from 0.002 to 0.4% by weight of titanium and/or from 0.05 to 0.8% by weight of manganese. Copper, iron and lead should be contained therein only in such amounts as are unavoidable as impurities of zinc and aluminum. Further improvements of the properties are possible with from 3 to 100 ppm of boron, from 3 to 100 ppm of carbon, from 3 to 50 ppm of magnesium, from 2 to 500 ppm of vanadium, from 2 to 500 ppm of silicon and/or from 2 to 500 ppm of nickel.

The improved properties of the alloys used according to the invention can be seen from comparative corrosion studies with the salt spraying test according to DIN 500 21- ss (storing for 7 or 14 days), and with the condensed water/SO_2 test according to DIN 50 018 KFW 0.2s (storage for 22 cycles). After the storage, the mass changes and the optical appearance of the corrosion of the sheets are established.

It was found that the plates and strips according to the invention exhibit a clearly improved corrosion resistance in the salt spraying test as compared to the previously used fine zinc alloys, which is manifested by a corrosion rate which is reduced by one power of ten. In the condensed water/SO_2 test according to DIN 50 018 KFW 0.2s, there was also found a clearly improved corrosion resistance as compared to the previously used fine zinc alloys.

Comparative studies in the salt spraying test according to DIN 50 021-ss in comparison with fine zinc alloys I and II in DE-A-195 45 487 have shown that the

mass loss can be reduced by at least another 80%. In the SO_2 test according to DIN 50 018 KFW 0.2s, the mass loss decreases by at least another 70% as compared to these alloys.

It is of particular importance that the risk of punctual deep corrosion as a consequence of mistakes of building physics and/or unprofessional laying is clearly reduced in the alloys according to the invention, and that the loss of metal can be minimized. Thus, the import of leached-out metals into the environment is also clearly reduced. This is demanded, for example, by the Dutch authorities.

The preferably co-alloyed elements indium, calcium, titanium and manganese have an influence, above all, on the mechanical properties, but they additionally improve the corrosion behavior.

Particularly good results are achieved with alloys having an aluminum content of from 5 to 20% by weight of aluminum, the range of from 8 to 15% by weight of aluminum being particularly preferred.

Impurities of more than 0.1% by weight of copper and of more than 0.1% by weight of iron lead to deteriorated mechanical properties and especially enhance intercrystalline corrosion. Thus, these metals and other impurities should be present only in the usual unavoidable amounts.

Although the contents of indium, calcium, titanium and manganese can be increased in principle, this would only result in an unnecessary increase in price of the material without noticeably further improving the properties.

The strips and plates which can be used as constructional zinc can be prepared by the usual casting-and-rolling process. In principle, all zinc grades according to EN 1179 can be used, the zinc grade Z1 being preferred because it contains relatively little lead, iron and copper.

Aluminum as an alloy component is preferably employed in the grades according to EN 576.